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# CREATING NOVEL PRODUCT FORM BASED ON FORMAL AESTHETICS – A METHOD FOR ADVANCED FORM DESIGN EDUCATION

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## ABSTRACT

One of the most distinct aspects of creativity in design is an aesthetic sense, an indubitable determinant of product success in the market. It is therefore of great importance to nurture creativity in terms of formal aesthetics in design education. However, the focus of design education has shifted away from product form and instead towards user-centred design (UCD) practices. An intrinsic challenge in the tradition of user-centred design is that it initiates creating products from the definition of some user needs, educating design solutions that are, to some extent, already known by the user, as familiarity factors are favoured. In our research, we turn the established UCD process around and propose an approach for exploring and creating novel product form with a focus on formal aesthetics. This paper elaborates on the Formal Aesthetics Design Approach that has been explored during a three-year case study, performed within a Masters programme in Industrial Design Engineering. A deep exploration of aesthetic form opportunities, consciously without any respect to user demands, was carried out by a structured five-step method. There was no ‘given’ or predefined aim for the form design process, which lead to a creative and experimental yet structured generation of formal solutions beyond the functionality of use. Hence, a variety of novel and unexpected form ideas emerged, broadening the morphological form repertoire as a result of the suggested method of work. This research illustrates benefits offered by applying a formal aesthetic design approach as a creative form generation process in design education.

*Keywords: Design process, formal aesthetics, form exploration, form generation, creativity, form innovation, form diversity*

## 1 INTRODUCTION

The most distinct feature of design is inventiveness and creativity [1]. Design is as a divergent task requiring creative and inventive thinking, which also includes stages of convergent thinking [2]. The importance of promoting innovative and creative thinking in design education and nurturing the students’ creative process has been repeatedly highlighted and emphasized by scholars [3-5]. Since the creative nature of design cannot be thought in classrooms, Schön [6] defined “*the reflective practicum*” which is the most commonly practiced approach in design education. The reflective practicum is exemplified by learning by doing and coaching for developing professional design skills through *knowing-in-action* and *reflection-in-action*.

Aesthetic sense is one of the many facets of inventiveness in design, offering novel products forms that have not been seen before [1]. Design aesthetics is “*the study of the effect of product gestalt on human sensation*” [7]. Different studies have emphasized the important role of product appearance in the competitive market today for attracting consumer attention [8]. However, this has lead to a market-driven form and product aesthetics, which implies developing products based on the preferences of a defined user group [9].

The concept development phase in product development generally starts from defining a set of user needs and requirements [10]. In other words, there is always a starting point in understanding user utility, function, context, motivation, cultural aspects etc., which is used to drive and target the design process apart from practical aspects. Consequently, the focus of design education has also shifted

towards a user-centered attitude, providing tools and methodologies for developing products that acknowledge users' conceptions and desires [11-13].

An intrinsic challenge with the UCD approach is that it is market-driven which, according to Parr [9], favors design solutions that are, to some extent, already known by the defined user. Thus, radical innovation, in terms of product form, is not prioritized since familiarity factors will always be preferred. Approaches, solely based on formal aesthetics, are rarely considered independently in design practice [9]. Additionally, aesthetics innovation as one of the key-foundations of design competence in design education is fading [11]. However, there is a great potential in exploring product form independently in teaching design innovation, as it offers the opportunity to create novel shapes and visual recognition in market. Research in formal aesthetics with regards to appearance of products have largely been focused on defining aesthetics as a universal visual language comprising of design principles, elements, and techniques [14-16] which influence the appearance of a product [17-19]. In educational context, the focus has been e.g. on the students' sketches and their visual analyses [20]. There is however a limited research into general models and approaches in order to describe how innovative aesthetic form and form expression is created and how it can be taught.

## **2 AIM**

To nurture design students' creative process with a focus on innovative aesthetic form generation, we shift the focus of design education that is commonly on UCD, and propose a formal aesthetics design approach (denoted FAEDA) for exploring and creating novel product form. Offering great opportunities for design students, this approach can be utilized as a creative form design tool to originate new and distinctive product forms. This paper elaborates on FAEDA in practice and describes its implementation and evaluation in an on-going Master course in Advanced Form Design. Three empirical studies were conducted to address the main question of this research; "how conceptual innovative product form development can be nurtured in design education by using a structured design approach with a focus on formal aesthetics?"

## **3 RESEARCH DESIGN**

The FAEDA was adopted in three consecutive courses in Advanced Form Design, conducted by the authors at Chalmers University of Technology in Sweden. Each course ran from January to March during spring terms 2008 – 2010. The main aim of the courses was for the students to exclusively work with a focus on formal aesthetic concepts and methods. The students were provided with tools and training for advanced form design and configuration of forms and formal systems, based on the theory and methods presented in lectures and course literature. The gained knowledge was to be applied in a seven-week design project, ongoing roughly 20-25 hours per week.

A combination of data collection methods was used to monitor, document, and evaluate the proposed approach; (i) observations from the weekly meetings and discussions with the students, (ii) retrospective self-reflective reports and (iii) final design results in the end of each course.

### **3.1 Course overview and the project framework**

The main obligatory part of the course was the group project work in which the students were to look for approaches that would lead to a creative and experimental yet structured generation of formal product solutions. In all three studies, the groups had a free choice of topic for their form generation projects. They were briefed to use aesthetic values and product novelty as driving forces in their design process. Furthermore, they were instructed not to focus on technical functionality during the form design development. The project consisted of two parts and the given design goal was that the result had to be innovative in terms of form expression or functionality. The first part of the project was divergent, following a structured five-step method. Unconstrained by convention, function, use and context, the students were to conduct a deep exploration of aesthetic form opportunities provided by a structured variation of basic geometrical parameters.

1. **Exploring** possible uses of basic design elements; bars, surfaces and volumes [15] to accumulate a collection of forms, which could stimulate formal imaginary solutions later in the process. The exploration can either be defined as to look for inspiration in the environment or from the students' own experience, by unrestrictedly producing CAD-models or freehand sketches.
2. **Categorizing** form applications into main groups according to types of application [16].
3. **Interpreting** selected form types with respect to associative and characterizing form drivers,

verbally describing the fundamental transformation for a form to emerge.

4. **Generating** a great variety of new shapes and geometries with the help of different tools. Abstract, three-dimensional forms originating from basic design elements were generated as individual entities and in arrangements and compositions with increasing complexity.
5. **Structuring** the generated new form variety in matrices according to solution types.

The second part of the FAEDA aimed to converge and choose the most interesting and appealing shapes, contextualize and transform the abstract form and apply it to a scenario of use to further develop the form into a product concept with a certain purpose, function and performance. Through applied form feasibility studies, CAD renderings and/or three-dimensional physical presentation models were developed as the final result of the design process.

The course organization followed Bloom's taxonomy [21] of educational objectives, from the initial phase of providing "knowledge" (through lectures and course literature) to later phases of "comprehension" (by exploring examples of available forms), "application" (through form generation), "analysis" (by structuring, categorizing and interpreting the data), "synthesis" (by the contextualization and further development of the form into a functional product), and "evaluation" (by means of self-reflective reports where participants gave a critical review on their design process and the use of tools and methods).

### 3.2 Participants

A total number of 111 students<sup>1</sup> (22-32 years old, 58 men and 53 women), enrolled in a Master program in Industrial Design Engineering, participated in three empirical studies. They all had a common experience from basic design courses in either industrial design or industrial design engineering. For carrying out the design project, they were encouraged to form groups of three to five students. Table 1 shows the distribution and characteristics of the participants of each study.

*Table 1. Distribution and characteristics of the participants in each study*

Empirical Study	Spring term/Year	Participants	Gender		Age
			Men	Women	
Empirical Study 1	2008	35	19	16	22-28
Empirical Study 2	2009	35	23	12	22-29
Empirical Study 3	2010	41	16	25	22-32

## 4 RESULTS

In the three courses during which the FAEDA was applied, roughly 35 projects with extensive variety of conceptual form design solutions were carried out. Each project had its own theme and structure, having interpreted and performed the steps slightly different in terms of choice of tools and mind-set. To illustrate an exemplary application of FAEDA, one of the group projects will be presented below. The project theme for this group was to work with different form languages; in particular to merge Scandinavian and Chinese form languages.

### 4.1 Part One

For the first part of the project, the group developed the following results, structured according to the five-stage framework:

1. **Exploring** possible form entities originating from the basic design elements of bar, surface and volume. This was done by collecting examples with design elements, represented in architecture, product design, automotive industry and nature to find inspiration that relates to Scandinavian and Chinese form expressions. The purpose was to identify differences and similarities between Scandinavian and Chinese form expressions.
2. **Categorizing** identified form applications into main groups according to types of application. Three main groups of form types (typologies) were selected; bar, surface and volume. Further sub-groups were created such as Basic forms, Grids, Connective forms, Intersecting forms, etc.
3. **Interpreting** the collected forms by using associative words, which described the characteristics of the form, so called form drivers, e.g. *elevated*, *connective* or *close-pack*. Each form was also

<sup>1</sup> The students were of different nationalities; fifty-one participants had Swedish nationality, and the rest were originating from Ireland, China, Iran, Netherlands, Spain, Turkey, Greece, Germany, Pakistan, and England.

classified as Chinese or Scandinavian and simplified in form of line drawings. Finally, the most common basic elements and expressions occurring among Scandinavian and Chinese forms were identified with the help of Design Format Analysis, proposed by Warell [19].

	Bars	Volumes	Surfaces
Intersection (crossing)			
Bent (hooked, turned, grip around edge, surround)			
Stretch (extrude, pulled out)			
Elevated			

Figure 1. A selection of forms, categorized into bars, volumes and surfaces including the interpretive form drivers

The results from exploring, categorizing, and interpreting were summarized and presented in different matrices. Figure 1 shows an exemplary matrix.

4. **Generating** a great variety of new shapes and geometries with the aid of the form drivers and the two-dimensional line sketches, starting with bars, and continuing with increasing complexity through surfaces and volumes, using hand sketches, and CAD models (fig. 2).
5. **Structuring** the result from the generation phase by using a questionnaire for crosschecking the visual appearance of the two form categories; Chinese and Scandinavian.

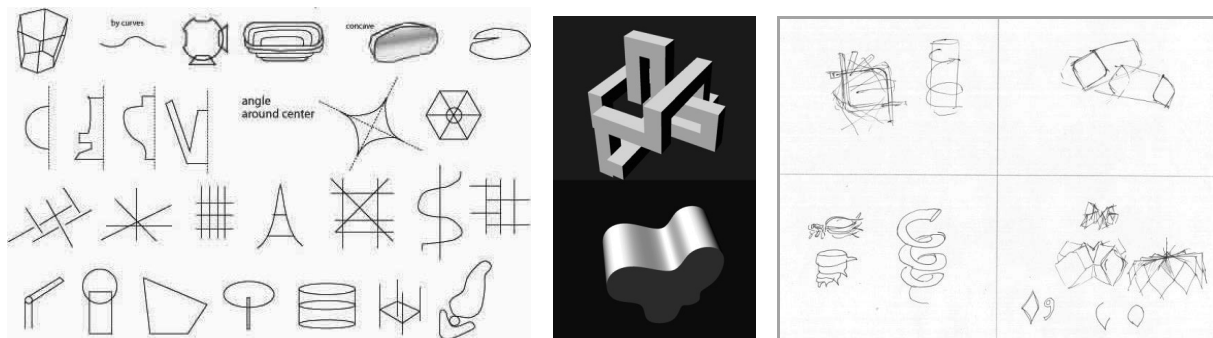


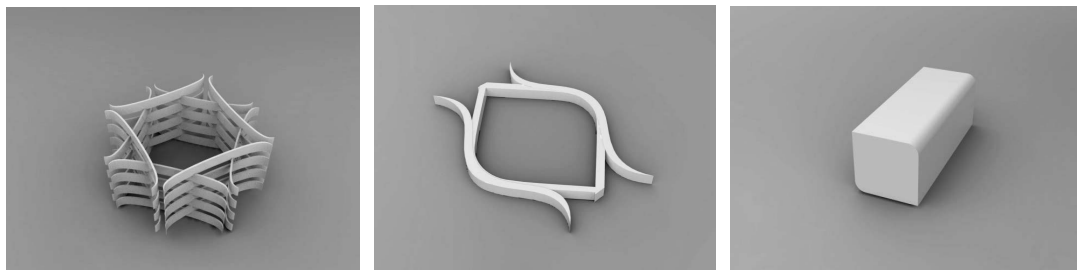
Figure 2 - Form generation CAD-models and freehand sketches.

#### 4.1 Part Two

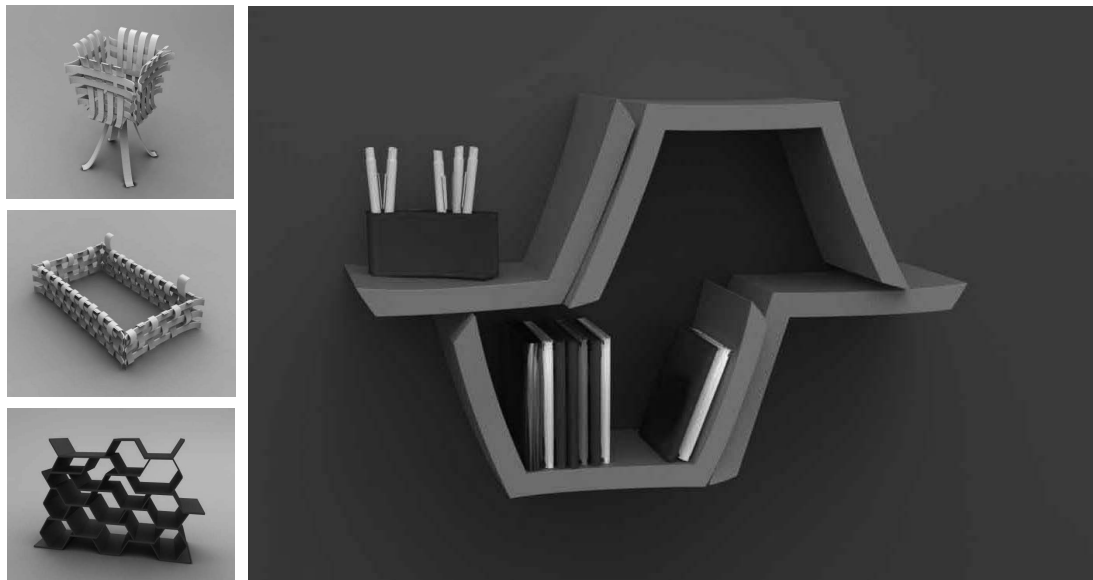
In the second part of the project, the results from the first part were evaluated. As a result three visually interesting and promising forms were selected in order to further develop and contextualize them into objects (fig. 3) representing:

- *Chinese form language* – “edgy and complex. It is appreciated by us for its harmonic and symmetric look – you might recognize the shapes from a traditional Chinese house”
- *A merge between Scandinavian and Chinese form language* – “it is sharp and pointy but still has flowing smooth properties. You associate the form to a leaf or a wave”
- *Scandinavian form language* – “It feels calm, it’s simple and soft, it has a leaf-like cross section”

Further, the project group finalized three products, only one of which - the Chinese form expression - is presented here. The development of the object took several iterations and the function varied from being a fire basket to a woven basket and finally to a bookshelf. These transformations and iterations were primarily based on the form drivers defined in the first part of the project. The group considered the final result to have “concave/convex surfaces common in traditional Chinese roofing” associating it to the great wall architecture.



*Figure 3. The three forms selected for further development, which exemplify (from left to right): Chinese form language, a merge between Scandinavian and Chinese form language, and Scandinavian form language*



*Figure 4. The iterative stages of the form development including the final result - a bookshelf expressing the Chinese form language; to the left the three stages: a fire basket, a woven basket and finally a bookshelf*

## 5 CONCLUDING REMARKS

Implementing the Formal Aesthetics Design Approach in three exploratory studies successfully illustrated the innovative potential in a non-determined open-ended form design and the necessity to regard the aesthetic potential and functionality of form. Applying FAEDA as creative form generation tool contributed to: (i) developing a taxonomy/terminology for discussing form quality and aesthetic expression and arguing for or against certain form values, (ii) investigating and creating a typology of three-dimensional forms on the level of element, structure and system, and (iii) exploring the transition between form and meaning in design.

According to the course evaluations, the students found the project rewarding and motivating, however also challenging and time consuming, as they spent a significant period of time accepting the approach as such, due to their preconditioning by more linear and strictly targeted design project training. Usually, a design project starts with identifying requirements that work as a binding force throughout a project, both in a good and a bad sense. On the one hand, every upcoming idea can immediately be evaluated in relation to these presettings. On the other hand, there is an underlying risk of suppressing or even eliminating open form creativity. In the proposed approach, there was no 'given' or predefined aim for the form design process, which lead to an experimental yet structured generation of formal solutions beyond the functionality of use. Hence, a variety of novel and unexpected form ideas emerged, broadening the morphological form repertoire as a result of the suggested method of work. Compared with numbers of unprejudiced formal operations that will not contribute to the final result, working with requirements from the beginning is more time-efficient. However, without FAEDA, it is probable that innovative formal solutions and ideas never appear.

Many participants were astounded how FAEDA can be used to influence form-innovation. A common opinion was in the end that these types of approaches are needed, in particular, when new ways are

sought to explore and experience the diversity and endless possibilities of advanced form design, definitely in design education but even - wherever suitable - in today's design work.

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## REFERENCES

- [1] Archer B. *The nature of research into Design and Technology education.*, In *DATER 91- 4th National Conference on Design and Technology Educational Research and Curriculum Development*. 1991, Loughborough: Loughborough University of Technology.
- [2] Lawson B. *How designers think: the design process demystified*. 2006, (Elsevier/Architectural).
- [3] Hope G. Beyond Knowing How to Make it Work: The conceptual foundations of designing. *Design and Technology Education: an International Journal*, 2009, 14(1).
- [4] Loewy A.F. *Teaching Design Innovation: Methods for Promoting Innovation in the University Industrial Design Studio*, In *The NCIIA 12th Annual Meeting* 2008, National Collegiate Inventors & Innovators Alliance (NCIIA): MA.
- [5] Wong Y. and Siu K. A model of creative design process for fostering creativity of students in design education. *International Journal of Technology and Design Education*, 2011: p. 1-14.
- [6] Schön D.A. *Educating the reflective practitioner: toward a new design for teaching and learning in the professions*. 1990, (Jossey-Bass).
- [7] Monö R. *Design for product understanding : the aesthetics of design from a semiotic approach* 1997, (Stockholm: Liber).
- [8] Creusen M.E.H. and Schoormans J.P.L. The Different Roles of Product Appearance in Consumer Choice. *Journal of Product Innovation Management*, 2005, 22(1): p. 63-81.
- [9] Parr J.W. Aesthetic Intentions in Product Design: Market driven or alternative form. *Produktdesign Artikkelsamling höst 2003*, 2003: p. 138–150.
- [10] Ulrich K.T. and Eppinger S.D. *Product Design and Development*. Fourth Edition 2008, (New York: McGraw-Hill/Irwin).
- [11] Boyarski D. Designing design education. *SIGCHI bulletin*, 1998, 30(3): p. 7.
- [12] Krippendorff K. *Design Research, an Oxymoron?*, In *Design research now: essays and selected projects*, R. Michel, Editor 2007 Birkhäuser: Zurich.
- [13] Leurs B., Mulder, I. & Waart, P van. *Developing A Human-Centered Attitude through experiential learning.*, In *4th IASDR World Conference on Design Research* 2011: Delft.
- [14] Akner-Koler C. Form & Formlessness: Questioning Aesthetics Abstractions through Art Projects, Cross-disciplinary studies and Product Design Education. 2007, *Doctor of Philosophy*. (Department of Architecture. Chalmers University of Technology, Sweden).
- [15] Knauer R. *Transformation: basic principles and methodology of design*. 2007, (Birkhauser).
- [16] Muller W. *Order and meaning in design*. 2001, (Lemma Publishers).
- [17] Coates D. *Watches tell more than time: product design, information, and the quest for elegance*. 2003, (McGraw-Hill).
- [18] Crilly N. Moultrie J., and Clarkson P.J. Seeing things: consumer response to the visual domain in product design. *Design Studies*, 2004, 25(6): p. 547-577.
- [19] Warell A. Design Syntactics: A Functional Approach to Visual Product Form Theory, Models, and Methods. 2001, *Doctoral thesis*. (Department of Product and Production Development. Chalmers University of Technology. Gothenburg, Sweden).
- [20] Haupt G. and Blignaut S. Uncovering learning outcomes: explicating obscurity in learning of aesthetics in design and technology education. *International Journal of Technology and Design Education*, 2008, 18(4): p. 361-374.
- [21] Krathwohl D.R. A Revision of Bloom's Taxonomy: An Overview. *Theory into Practice*, 2002, 41(4): p. 212-218.